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SECTION 1.0
INTRODUCTION

This Air Quality Monitoring Report presents a summary of air quality monitoring conducted by Atlantic Richfield Company ("ARC") at the Yerington Mine Site during the fourth quarter of 2006 ("4Q 2006") and for the entire year of 2006. A description of field activities and data verification for air quality data and meteorological data is presented for 4Q 2006, and a discussion of the analytical results for air quality data and meteorological data is provided for the entire year of 2006. Electronic files of 2006 analytical and meteorological data are provided as Appendices D and H, respectively, in Microsoft Excel format for the entire year of 2006.

Monitoring activities were conducted according to the *Draft Air Quality Monitoring Work Plan for the Yerington Mine Site* ("Work Plan") prepared by Brown and Caldwell on December 22, 2004 (Brown and Caldwell, 2004a) and conditionally approved on January 19, 2005 by the U.S. Environmental Protection Agency ("EPA", 2005). A final version of the Work Plan was prepared by Brown and Caldwell on December 19, 2005 (Brown and Caldwell, 2005a). Air quality monitoring was conducted on the National Ambient Air Quality Standards ("NAAQS") monitoring schedule, which consists of sampling on every sixth day.

Air quality monitoring has been conducted at six locations located around the perimeter of the site (AM-1 through AM-6, shown on Figure 1). Each location was established to assess potential fugitive dust emissions from the site and monitor: 1) particulate matter of a diameter of 10 microns or less (PM_{10}) with a high volume sampler; 2) total suspended particulates (TSP) with a separate high volume air sampler; and 3) concentrations of selected metals and radiochemicals collected on the PM_{10} and TSP filters. Monitoring location AM-1 was established with a second PM_{10} high volume air sampler, co-located with the primary sampler, for duplicate analyses. Monitoring location AM-6 was sited near the site meteorological station.

Air monitoring began with Event 1 on January 28, 2005. The Work Plan specified gravimetric analysis of PM_{10} and TSP filters and chemical analysis of 21 metals and ten radiochemicals

present on PM_{10} and TSP filters. The TSP high volume air samplers were shut down from March 2, 2005 to June 1, 2005 pending resolution on the analyte list. Air monitoring continued per the Work Plan through Event 87 on June 28, 2006.

Beginning with Event 88 on July 4, 2006, the air monitoring program scope was revised per the EPA letter dated June 16, 2006. PM_{10} monitoring was terminated at air monitoring locations AM-2, AM-4, and AM-5 and TSP monitoring was terminated at AM-1, AM-2, AM-3, AM-4, and AM-5. During 4Q 2006, PM_{10} high volume air samplers operated at AM-1, AM-3, and AM-6 and one TSP high volume air sampler operated at AM-6. The list of metals to be analyzed was reduced from 21 to eight: aluminum, arsenic, cadmium, chromium, cobalt, copper, manganese, and nickel. Sulfate was added as an analysis. The list of radiochemicals to be analyzed was reduced from ten to five: gross alpha, radium 226, radium-228, thorium-228, and thorium-230.

All high volume samplers were shut down following the completion of Event 116 on December 19, 2006 according to the schedule proposed in the *Draft Revised Air Quality Monitoring Work Plan for the Yerington Mine Site* prepared by Brown and Caldwell on November 21, 2006 (Brown and Caldwell, 2006). The high volume samplers will continue operation in February 2007 following construction activities and installation of new air monitoring equipment.

SECTION 2.0
FIELD ACTIVITIES

Field activities during 4Q 2006 consisted of calibration, auditing, monitoring, and maintenance. A summary of these activities is presented in Table 1. Field activities were conducted according to Standard Operating Procedures (SOPs) provided in the *Quality Assurance Project Plan, Yerington Mine Site, Revision 1* ("QAPP")(ESI et al, 2006) and the revised *Site Health and Safety Plan* (Brown and Caldwell, 2005b).

2.1 Calibration

Calibration activities consisted of quarterly calibration of the high volume air samplers and semi-annual calibration of the meteorological station.

2.1.1 High Volume Air Sampler Calibration

The Work Plan specified that the high volume air samplers would be calibrated according to the following schedule:

- Upon installation;
- After any motor maintenance;
- Once every quarter (3 months); and
- After 360 hours.

The AM-6-PM10 high volume air sampler was recalibrated on November 10, 2006 following the replacement of the motor. The AM-6-PM10 high volume air sampler was recalibrated again on November 15, 2006 following the replacement of the mass flow controller.

The Work Plan specified a minimum of five calibration points for all high volume samplers. In addition, three calibration points must be within 1.02 to 1.24 cubic meters per minute (m^3/min) for the PM_{10} high volume air samplers. The Work Plan also specified a calibration correlation

coefficient greater than 0.99 for all high volume samplers. The calibration data sheets and charts for each high volume air sampler are provided in Appendix A. All calibration requirements were achieved.

2.1.2 Meteorological Station Calibration

The Work Plan specified that the calibration of the meteorological station would be conducted at the start of the program and on a semi-annual basis thereafter. The annual calibration is scheduled for first quarter 2007. The rain gauge was recalibrated on October 25, 2006 following part replacement.

2.2 Auditing

The EPA representative conducted an audit during December 28 to 29, 2006 that consisted of:

- EPA and manufacturer-approved audit of four PM_{10} high volume air samplers and one TSP high volume air sampler using certified audit orifice (completed December 28, 2006); and
- Prevention of Significant Deterioration (PSD)-quality audit of 10-foot meteorological tower (completed December 29, 2006).

The audit report will be included in the first quarter 2007 report.

2.3 Monitoring

Monitoring activity consisted of air monitoring and meteorological monitoring, as described below.

2.3.1 Air Monitoring

The Work Plan specified that air monitoring would be conducted according to the NAAQS monitoring schedule for PM_{10}. Air monitoring during 4Q 2006 was conducted every sixth day beginning with Event 103 on October 3, 2006 through Event 116 on December 19, 2006 for a total of 14 events. Field data sheets and total volume calculations are provided in Appendix B.

Sample volumes were calculated using the average daily temperature and barometric pressure from the meteorological station, and calibration chart slopes and intercepts as specified in the *Reference Method for the Determination of Particulate Matter as PM-10 in the Atmosphere* (EPA, 1998a) and the *Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High-Volume Method)* (EPA, 1998b). The sample volumes for PM_{10} and TSP samples are summarized in Tables 2 and 3, respectively. The following are notable occurrences for the air monitoring during this reporting period.

- During Event 108 on November 1, 2006, the AM-6-PM10 mass flow controller was erratic and a valid sample was not obtained.
- During Event 109 on November 7, 2006, the AM-6-PM10 mass flow controller was erratic again. The AM-6-PM10 motor was replaced and the unit was re-calibrated on November 10, 2006. The AM-6-PM10 mass flow controller was replaced and the unit was re-calibrated again on November 15, 2006.

2.3.2 Meteorological Monitoring

Meteorological monitoring was conducted with the site meteorological station during 4Q 2006. The following parameters were measured:

- Precipitation in inches;
- Temperature in degrees Fahrenheit (ºF);
- Relative humidity in percent;
- Barometric pressure in milliBars (mBar);
- Solar radiation in kiloJoules per square meter (kJ/m^2);
- Wind speed in miles per hour (mph); and
- Wind direction in degrees.

Meteorological data was collected from the station at 15-minute intervals from October 1, 2006 to December 31, 2006. Selected meteorological data is summarized on Table 4 for monitoring events during this reporting period and for all of 2006.

2.4 Maintenance

Maintenance activity consisted of troubleshooting, part replacement, and routine maintenance on the high volume air samplers and routine maintenance and part replacement on the meteorological station.

2.4.1 High Volume Air Samplers

The motor and mass flow controller were replaced on the AM-6-PM10 high volume air sampler. Minor routine maintenance included the replacement of recorder pens for the Dickson chart recorders and re-greasing of shim plates on the PM_{10} high volume air samplers.

The Work Plan specified that motor brushes would be checked or replaced every 300 to 500 hours of operation. Cumulative operational hours for each blower motor in service during 4Q 2006 are provided in Appendix C. After the completion of Event 116 on December 19, 2006, the motors for AM-1-PM10, AM-1-PM10-DUP, AM-3-PM10, AM-6-PM10, and AM-6-TSP high volume air samplers had accumulated between 240 and 408 hours of operation. The motors in these high volume air samplers will be replaced in first quarter 2007.

2.4.2 Meteorological Station

Routine maintenance conducted on the meteorological station during this reporting period consisted of ensuring that the tipping bucket was aligned to vertical. On October 2, 2006 at 11:45 a.m., the rain gauge was damaged when a truck backed into it. A complete replacement unit was installed on October 25, 2006. The new rain gauge was calibrated and returned to service on October 25, 2006 at 10:00 a.m.

SECTION 3.0
AIR QUALITY DATA VERIFICATION AND VALIDATION

Severn Trent Laboratories performed the gravimetric analyses of PM_{10} and TSP filters, and chemical analysis of metals and radiochemicals present on both PM_{10} and TSP filters, for Event 103 on October 3, 2006 through Event 116 on December 19, 2006. Analytical results were provided by the laboratory electronically in a format specified by Brown and Caldwell. The laboratory electronic data deliverables (EDDs) were uploaded automatically into the project database, which consists of a Microsoft SQL Server database with a Microsoft Access user interface. The analytical results are provided electronically on compact disc in Microsoft Excel format in Appendix D. The laboratory reports are provided electronically on compact disc in Adobe Acrobat PDF in Appendix E.

3.1 Data Verification

All air quality data was verified according to the quality control (QC) criteria provided in the QAPP. The items listed in the following table were verified for analytical data.

Data Verification Requirements

Review Item	Checked During Data Verification
Case Narrative	X
Chain-of-Custody Documentation	X
Summary of Results	X
Holding Times	X
Method Blank Analysis Results	X
Field/Trip Blank Analysis Results	X
Surrogate Standard Percent Recoveries (%R)	X
Laboratory Control Samples (LCS) - %R	X
LCS/LCS Duplicate (LCSD) - Relative Percent Difference (RPD)	X
Field Duplicate (FD) - RPD	X

A detailed QC report is provided for 4Q 2006 in Appendix F. In summary, the verification indicates that the majority of analytical data generated during 4Q 2006 are usable with no data rejected. Notable findings from the QC report are provided below.

- Data Completeness: The Work Plan specified a data completeness goal of quarterly valid data retrieval of 80 percent for air quality data. The completeness goal was to be tracked for each of the six monitoring locations (AM-1 through AM-6). If one or more of the high volume air samplers malfunctioned during a sampling event, such that valid data could not be retrieved, then a makeup run could be conducted on the immediately following 3-day event specified in the NAAQS schedule. Fourteen sampling events were conducted during 4Q 2006, as summarized in Table 5. There were two exceptions to the sampling and analysis plan this reporting period. During Event 108 on November 1, 2006 and Event 109 on November 7, 2006, the AM-6-PM10 mass flow controller was erratic and valid samples were not obtained. A total of 54 primary samples were collected out of 56 planned. The actual completeness for air quality data was calculated to be 96 percent, which exceeds the 80 percent program goal.
- Sample Hold Time: Four samples were analyzed out of hold time for sulfate.
- Field Duplicates: The Work Plan specified a collection frequency goal of 10 percent for field duplicates. The total number of primary samples targeted during this reporting period was 56. A total of 7 field duplicate samples were collected and analyzed for all the analytes as the primary samples. An additional field duplicate was only analyzed for PM_{10} only. The actual frequency of field duplicate collection was 12 percent, which is above the program goal of 10 percent. Field duplicate precision for metals and radiochemicals are provided in Table 6.
- Field Blanks and Trip Blanks: The Work Plan specified a collection frequency goal of 5 percent for field blanks and 5 percent for trip blanks. Three field blanks and two trip blanks were collected during this reporting period as shown on Tables 7a and 7b. The total number of primary samples targeted during this reporting period was 56. The actual frequency of field blank collection was 5.4 percent, which meets the program goal of 5 percent. However, the actual frequency of trip blank collection was only 3.6 percent, which is below the 5 percent goal. A total of 21 results were qualified as not detected with an estimated detection limit due to the presence of cadmium, chromium, copper, nickel and thorium-230 in associated field/trip blanks as described in Appendix F. Field procedures for sample handling were reviewed, and no sample collection issues were identified.
- Method Blanks: A total of 27 results were qualified as not detected with an estimated detection limit due to the presence of arsenic, sulfate, radium-228 and thorium-230 in associated method blanks as described in Appendix F.

3.2 Data Validation

The Work Plan specified that 10 percent of the air quality data would be validated by a third party. The data validation reports generated during this reporting period are provided electronically on compact disc in Adobe Acrobat PDF in Appendix G. The data verification requirement was mainly concerned with metals and radiological analyses since gravimetric

analytical methods specify minimal QC. Third party data validation is currently being conducted by ESI for the Sample Delivery Groups (SDGs) associated with the monitoring events indicated below.

Status of 3rd Party Data Validation

Event	SDGs	Chemical Analyses	Report Date	Validator	Location
3	G5H260309	Metals	11/2/05 3/31/06 Revision A	Veridian	3Q 2005 Report 2Q 2006 Report
3	30354	Radiochemicals	4/3/06	ESI	2Q 2006 Report
13	G5H260363	Metals	11/2/05 3/31/06 Revision A	Veridian	3Q 2005 Report 2Q 2006 Report
13	30401	Radiochemicals	4/12/06	ESI	2Q 2006 Report
23	G5F170169 & G5F170175	Metals	8/31/05 3/31/06 Revision A	Veridian	3Q 2005 Report 2Q 2006 Report
23	29297	Radiochemicals	3/31/06	ESI	2Q 2006 Report
33	G5H100234	Metals	10/25/05 1/18/06 Revision A 3/31/06 Revision B	Veridian	3Q 2005 Report 4Q 2005 Report 2Q 2006 Report
33	30037	Radiochemicals	3/31/06	ESI	2Q 2006 Report
43	G5J120301	Metals	1/17/06 3/31/06 Revision A	Veridian	4Q 2005 Report 2Q 2006 Report
43	31081	Radiochemicals	4/6/06	ESI	2Q 2006 Report
53	G5L090197	Metals	3/2/06	Veridian	4Q 2005 Report
53	31489	Radiochemicals	4/27/06	ESI	2Q 2006 Report
63	G6B140190	Metals	4/6/06	ESI	2Q 2006 Report
63	32013	Radiochemicals	6/28/06	ESI	2Q 2006 Report
74	G6D190170	Metals	9/5/06	ESI	2Q 2006 Report
74	32362	Radiochemicals	10/19/06	ESI	3Q 2006 Report
83	32815	Radiochemicals	8/22/06	ESI	2Q 2006 Report
84	G6F190128	Metals	8/24/06	ESI	2Q 2006 Report
93	33473	Radiochemicals	11/16/06	ESI	3Q 2006 Report
94	G6H220236	Metals	10/16/06	ESI	3Q 2006 Report
104	G6J200155	Metals	1/9/07	ESI	4Q 2006 Report
104	33896	Radiochemicals	2/2/07	ESI	4Q 2006 Report
113	34418	Radiochemicals	3/8/07	ESI	4Q 2006 Report
114	G6L200199	Metals	2/23/07	ESI	4Q 2006 Report

SECTION 4.0
METEOROLOGICAL DATA VALIDATION

Meteorological data was downloaded electronically from the meteorological station on approximately a weekly basis. The electronic files were uploaded automatically into the project database. The complete meteorological data are provided electronically on compact disc in Microsoft Excel format in Appendix H.

All meteorological data were validated according to the criteria provided in the Work Plan. The validation routines were programmed in Microsoft Visual Basic and incorporated into the Microsoft Access database as modules that can be run on a selected date range. The validation results are provided in the following sections for data completeness, wind speed, wind direction, temperature, solar radiation, barometric pressure, and relative humidity.

In summary, with the exception of the precipitation data, the verification indicates that the meteorological data generated during this period are usable with no records flagged as rejected.

4.1 Data Completeness

The Work Plan specified a data completeness goal of quarterly valid data retrieval of 90 percent for meteorological data. Three months of meteorological data were collected during 4Q 2006 as summarized in Table 8. A total of 8,795 data were collected out of 8,832 planned. A total of 37 records from 8:00 a.m. to 5:00 p.m. on December 29, 2006 were flagged as rejected due to the EPA audit of the meteorological station. The actual completeness for meteorological data was calculated to be 99 percent, which exceeded the program goal of 90 percent.

4.2 Wind Speed

The Work Plan specified three validation criteria for wind speed:

- Less than zero or greater than 56 mph [25 meters per second (m/s)];
- Does not vary by more than 0.2 mph (0.1 m/s) for 3 consecutive hours; and
- Does not vary by more than 1.1 mph (0.5 m/s) for 12 consecutive hours.

No records were flagged for any wind speed criteria during this reporting period.

4.3 Wind Direction

The Work Plan specified three validation criteria for wind direction:

- Less than zero or greater than 360°;
- Does not vary by more than 1 degree for more than 3 consecutive hours; and
- Does not vary by more than 10 degrees for 18 consecutive hours.

No wind direction records were flagged for any of the three criteria during this reporting period.

4.4 Temperature

The Work Plan specified four validation criteria for temperature:

- Greater than the local record high;
- Less than the local record low;
- Greater than a 18°F (10 degrees Celsius or °C) change from the previous hour; and
- Does not vary by more than 1°F (0.5°C) for 12 consecutive hours.

Seven records (November 11, 21 and December 25, 26) were flagged due to the third temperature criteria.

The following temperature records provide high and low temperatures recorded by the meteorological station by month.

Site Temperatures Compared to Local Records				
	Site Data (ºF)		Local Record[1] (ºF)	
2006	High	Low	High	Low
October	77.30	22.45	93	5
November	75.40	9.26	80	-5
December	59.96	-1.02	74	-20

[1]Source: NWS/COOP Station 269229 located in Yerington, Nevada

These data include local record highs and lows from National Weather Service Cooperative Observer Program (NWS/COOP) Station 269229 in Yerington, Nevada. No temperature records were flagged for being either greater than the local record high or less than the local record low.

4.5 Solar Radiation

The Work Plan specified the following two validation criteria for solar radiation:

- Greater Than Zero at Night: The times for sunset and sunrise were obtained for every day of the year for Yerington, Nevada from the Astronomical Applications Department of the U.S. Naval Observatory. For the purposes of evaluating this criterion, night was defined as the meteorological station measurement readings that occurred between the time for sunset and sunrise on a given day. A total of 4,323 records were flagged for this criterion. The majority of records (4,192) that were flagged were less than 1 kJ/m^2 which, given the sensitivity of the sensor, is generally considered to be zero. The remaining 131 records that were flagged (range of 1.00 to 26.45 kJ/m^2) occurred at the calculated sunrise or sunset. The solar radiation data was determined to be usable (no corrective action necessary).
- Greater Than the Maximum Possible for the Date and Latitude: The maximum possible solar radiation for the middle day of each month for Yerington, Nevada was calculated using *Evaporation, Evapotranspiration, and Climatic Data – Developments in Atmospheric Science 22* (Burman, et. al., 1994) and summarized below. The solar radiation measurements from the meteorological station were totaled for each day during this reporting period and compared to the maximum possible. A total of 2,467 records were flagged for this criterion during this reporting period.

Maximum Solar Radiation[1] (kJ/m^2 day)	
October	18,016
November	12,794
December	8,282

[1](Burman, et. al., 1994)

4.6 Barometric Pressure

The Work Plan specified two validation criteria for barometric pressure:

- Greater than the local record high; and
- Less than the local record low.

Local record highs and lows were obtained from the Automated Weather Observing Station (AWOS) 93102 located in Fallon Naval Air Station, Nevada. For purposes of comparison, the mean sea level pressure was estimated using a modified National Oceanic and Atmospheric Administration (NOAA) method. No barometric pressure records were flagged for either criterion during this reporting period.

4.7 Relative Humidity

The Work Plan specified two validation criteria for relative humidity which are described below followed by a discussion of the validation results.

- Less than 30 Percent During Precipitation Events: For the purposes of evaluating this criterion, a precipitation event was defined as a precipitation reading greater than zero inches. No records were flagged for this criterion during this reporting period.
- Varies by 30 Percent of the Local Average for 24 Consecutive Hours: Local average relative humidity by month was obtained from AWOS Station 93102 located in Fallon Naval Air Station, Nevada. No records were flagged for this criterion during this reporting period.

Local Average Relative Humidity[1]	
October	45%
November	57%
December	55%

[1]Source: AWOS Station 93102 located in Fallon Naval Air Station, Nevada

4.8 Precipitation

The precipitation data for September 2006 of 11.07 inches reported in the 3rd quarter report was incorrect. Erroneous readings were obtained by the data logger from the precipitation sensor that persisted through 4th quarter. During construction activities in late December 2006, the precipitation sensor was dismantled for re-location and inspected closely. Improper shielding in the control cable was suspected to cause the erroneous readings. The cable was replaced with a new, shielded cable supplied by Campbell Scientific. The precipitation readings from September

1, 2006 through December 31, 2006 have been flagged as rejected. The precipitation measurements for 2006 from the mine site and a local station are summarized in the following table.

Precipitation Summary		
2006	**Mine Site (in)**	**Local Station[1] (in)**
January	0.81	1.11
February	1.31	0.43
March	0.76	0.57
April	1.42	0.48
May	0.03	0.00
June	0.00	0.00
July	1.04	0.40
August	0.00	0.00
September	---	0.00
October	---	0.20
November	---	0.00
December	---	0.00

[1]Source: NWS/COOP Station 269229 located in Yerington, Nevada

SECTION 5.0
SUMMARY AND DISCUSSION OF RESULTS

This section summarizes the results of air quality analyses and meteorological monitoring. Note that background concentrations of particulate matter, metals and radiochemicals in the area of the Yerington Mine under the range of observed meteorological conditions have yet to be determined, and would be required prior to a meaningful interpretation of the analytical results.

5.1 Air Quality Data

Air quality data generated during this reporting period consisted of gravimetric analysis of PM_{10} and TSP filters, and chemical analyses of metals and radiochemicals present on both PM_{10} and TSP filters. The analytical results for all quarters of 2006 are summarized in tabular format and provided in Appendix I. Note that the quantity of chemical analyses performed on the filters affects the detection limits achievable for the project since each analysis requires a portion of the total filter be sectioned for digestion. In general, the less filter area available for digestion corresponds to less of the chemical available to measure, which results in higher detection limits.

5.1.1 Gravimetric PM_{10} Results

Analytical results for PM_{10} during 2006 are summarized in Appendix I. Masses ranged from 100 to 67,400 µg. The masses detected on the PM_{10} filters were divided by the sample volumes in cubic meters in Table 2 to calculate PM_{10} concentrations in micrograms per cubic meter ($\mu g/m^3$), summarized in Table 9. Per the revised monitoring program, PM_{10} was monitored only at locations AM-1, AM-3 and AM-6 during 3rd and 4th quarters of 2006. As shown below, PM_{10} concentrations in 2006 ranged from 0.06 to 39.6 $\mu g/m^3$.

Gravimetric PM_{10} Results, Annual 2006						
Location	**Total Count**	**Qty. of Detects**	**Minimum ($\mu g/m^3$)**	**Average ($\mu g/m^3$)**	**Maximum ($\mu g/m^3$)**	**Qty. Detects >= NAAQS**
AM-1-PM10	55	54	0.07	9.0	25.8	0
AM-1-PM10-DUP	49	48	0.06	8.4	24.3	0
AM-2-PM10	29	28	0.2	7.1	29.9	0
AM-3-PM10	59	58	0.06	8.1	21.2	0
AM-4-PM10	28	28	0.9	10.6	39.6	0
AM-5-PM10	28	28	0.8	9.5	34.0	0
AM-6-PM10	54	54	0.1	10.9	26.0	0

The PM_{10} concentrations for each event in 2006 are charted on Figure 2. General observations regarding PM_{10} measurement during 2006 are described below.

- Average PM_{10} concentrations were highest in 2nd and 3rd quarters.
- Average PM_{10} concentrations at monitoring locations AM-4 through AM-6 were higher than average concentrations at monitoring locations AM-1 through AM-3 during 2006. Monitoring location AM-2 had the lowest average PM_{10} concentration of 7.1 $\mu g/m^3$ and monitoring location AM-6 had the highest average PM_{10} concentration of 10.9 $\mu g/m^3$.
- The maximum PM_{10} concentration of 39.6 $\mu g/m^3$ during 2006 occurred at AM-4-PM10 during Event 60 on January 17, 2006. Even this measurement was below the NAAQS for PM_{10}.

The current NAAQS primary standard for PM_{10} (50 $\mu g/m^3$) is averaged over a year at each monitoring location. NAAQS also specifies that each monitoring location have no more than one measurement per year above 150 $\mu g/m^3$ averaged over 24 hours. Average PM_{10} concentrations by monitoring location during 2006 ranged from 7.1 to 10.9 $\mu g/m^3$, which are well below the primary standard of 50 $\mu g/m^3$.

5.1.2 Gravimetric TSP Results

Analytical results for TSP during 2006 are summarized in Appendix I and ranged from 2,300 to 183,000 µg. The masses detected on the PM_{10} filters were divided by the sample volumes in cubic meters in Table 3 to calculate TSP concentrations in $\mu g/m^3$, which are summarized in Table 10. Per the revised monitoring program, TSP was monitored only at location AM-6 during the 3rd and 4th quarters of 2006. As shown below, TSP concentrations ranged from 1.2 to 96.7 $\mu g/m^3$.

Gravimetric TSP Results, Annual 2006						
Location	Total Count	Qty. of Detects	Minimum ($\mu g/m^3$)	Average ($\mu g/m^3$)	Maximum ($\mu g/m^3$)	Qty. Detects >= NAAQS
AM-1-TSP	28	28	1.2	18.5	57.3	0
AM-2-TSP	29	29	1.8	16.8	62.3	0
AM-3-TSP	28	28	2.8	16.3	45.9	0
AM-4-TSP	27	27	3.2	24.2	80.0	1
AM-5-TSP	28	28	3.5	25.2	96.7	1
AM-6-TSP	58	58	3.1	24.2	51.5	0

The TSP concentrations for each event in 2006 are charted on Figure 3. General observations regarding TSP measurement during 2006 are described below.

- Average TSP concentrations were highest in 2nd and 3rd quarters.
- Average TSP concentrations at monitoring locations AM-4 through AM-6 were higher than average concentrations at monitoring locations AM-1 through AM-3 during 2006. Monitoring location AM-3 had the lowest average TSP concentration of 16.3 $\mu g/m^3$ and monitoring location AM-5 had the highest average TSP concentration of 25.2 $\mu g/m^3$.
- The maximum TSP concentration of 96.7 $\mu g/m^3$ during 2006 occurred at AM-5-TSP during Event 63 on February 4, 2006.

Prior to 1987, the NAAQS primary standard for particulate matter, measured as TSP, was set at 75 $\mu g/m^3$ averaged over a year at each monitoring location. Average TSP concentrations by monitoring location during 2006 ranged from 16.3 to 25.2 $\mu g/m^3$, which are well below the TSP primary standard of 75 $\mu g/m^3$, which was discontinued by EPA in 1987 (note that after 1987, the NAAQS primary standard for particulate matter was measured as PM_{10}).

5.1.3 Metals Results

During 1Q and 2Q 2006, a total of 21 metals were analyzed from PM_{10} and TSP filters by the methods indicated below.

- ICP: five metals (aluminum, calcium, iron, magnesium, and sodium) were analyzed by inductively coupled plasma (ICP).
- ICP/MS: fifteen metals (arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc) were analyzed by inductively coupled plasma/mass spectrometry (ICP/MS).
- CVAA: mercury was analyzed by cold vapor atomic adsorption (CVAA).

According to the revised monitoring program, a total of 8 metals were analyzed from PM_{10} and TSP filters by the methods indicated below during 3Q and 4Q 2006.

- ICP: aluminum was analyzed by ICP.
- ICP/MS: seven metals (arsenic, cadmium, chromium, cobalt, copper, manganese, and nickel) were analyzed by ICP/MS.

Analytical results for metals detected on PM_{10} and TSP filters during 2006 are summarized in Appendix I. The masses detected on the PM_{10} filters were divided by the sample volumes in Table 2 to calculate the metals concentrations summarized in Table 9. The masses detected on the TSP filters were divided by the sample volumes in Table 3 to calculate the metals concentrations summarized in Table 10. A summary table of each metal is provided below in alphabetical order.

Annual 2006	PM-10 Filters (ng/m^3)					TSP Filters (ng/m^3)				
Analyte	Sample Count	Qty. of Detects	Average Result	Min MDL	Max Detected Result	Sample Count	Qty. of Detects	Average Result	Min MDL	Max Detected Result
ALUMINUM	301	264	140	13.93	661	199	196	285	18.21	1127
ARSENIC	301	27	0.94	0.39	2.36	199	35	0.99	0.32	3.38
BARIUM	200	0	20.25	11.88	N/A	170	0	17.82	15.53	N/A
BERYLLIUM	200	48	0.01	0.00	0.02	170	75	0.01	0.00	0.06
CADMIUM	301	162	0.04	0.01	0.30	199	136	0.06	0.01	2.37
CALCIUM	200	25	536	307	974	170	80	585	401	1686
CHROMIUM, TOTAL	301	6	4.45	1.00	2.35	199	10	4.69	0.85	1.75
COBALT	301	4	1.91	1.00	4.02	199	5	1.83	0.85	5.19
COPPER	301	294	12.59	0.57	62.57	199	199	57.62	0.48	337
IRON	200	151	190	4.91	3408	170	151	440	6.47	9245
LEAD	200	187	0.90	0.11	3.22	170	161	1.24	0.15	8.12
MAGNESIUM	200	119	97.25	33.20	242	170	154	177	43.39	551
MANGANESE	301	268	6.08	0.64	22.36	199	186	11.23	0.74	45.29
MERCURY	200	41	0.02	0.00	0.15	170	55	0.02	0.00	0.06
MOLYBDENUM	200	7	0.64	0.37	0.90	170	11	0.59	0.49	1.92
NICKEL	301	46	1.76	0.52	27.24	199	28	1.68	0.44	2.66
SELENIUM	200	3	0.99	0.58	1.33	170	5	0.88	0.75	1.90
SILVER	200	58	0.01	0.00	0.06	170	108	0.02	0.00	0.15
SODIUM	200	8	1197	690	2428	170	25	1160	902	5441
VANADIUM	200	25	1.94	0.99	3.06	170	46	2.05	1.29	4.99
ZINC	200	95	4.47	2.11	19.54	170	126	5.53	2.76	16.11

Analytical results are presented in nanograms/m^3 (1,000 nanograms = 1 microgram) for ease of presentation. Non-detected results were included in the average concentration calculation by assuming the metal was present at the detection limit. This assumption will result in some averages having a high bias compared to the actual average concentration.

5.1.4 Radiochemical Results

During 1Q and 2Q 2006, a total of 10 radiochemicals were analyzed from PM_{10} and TSP filters by the methods indicated below.

- Gas Proportional Counters: gross alpha and gross beta were analyzed by EPA Method 900.0 and radium-228 was analyzed by EPA Method 904.0.
- Alpha Scintillation Counter: radium-226 was analyzed by EPA Method 903.1.
- Alpha Spectrometry: three species of thorium (228, 230, and 232) were analyzed by Standard Method 7500-U-C and ASTM Method D-5174 and three species of uranium (234, 235, and 238) were analyzed by EPA Method 908.0.

According to the revised monitoring program, a total of 6 radiochemicals were analyzed from PM_{10} and TSP filters by the methods indicated below during 3Q and 4Q 2006.

- Gas Proportional Counters: gross alpha was analyzed by EPA Method 900.0 and radium-228 was analyzed by EPA Method 904.0.
- Alpha Scintillation Counter: radium-226 was analyzed by EPA Method 903.1.
- Alpha Spectrometry: three species of thorium (228, 230, and 232) were analyzed by Standard Method 7500-U-C and ASTM Method D-5174.

Analytical results for the radiochemicals detected on PM_{10} and TSP filters during 2006 are summarized in Appendix I. The activity values detected on the PM_{10} filters were divided by the sample volumes in Table 2 to calculate radiochemical concentrations, which are summarized in Table 11. The activity values detected on the TSP filters were divided by the sample volumes in Table 3 to calculate radiochemical concentrations, which are summarized in Table 12. A summary table of each radiochemical is provided below in alphabetical order. Analytical results are presented in femtoCuries/m^3 (1,000 femtoCuries = 1 picoCurie) for ease of presentation.

Non-detected results were included in the average concentration calculation by assuming that the radiochemical was present at the detection limit. This assumption may result in some averages having a high bias compared to the actual average concentration.

Annual 2006	PM-10 Filters (fCi/m^3)					TSP Filters (fCi/m^3)				
Analyte	Sample Count	Qty. of Detects	Average Result	Min MDL	Max Detected Result	Sample Count	Qty. of Detects	Average Result	Min MDL	Max Detected Result
ALPHA, GROSS	301	111	3.82	0.64	46.83	199	71	3.50	0.53	15.13
BETA, GROSS	200	185	12.87	1.74	102.24	170	158	13.17	2.04	37.18
RADIUM-226	301	20	0.38	0.10	3.16	199	13	0.31	0.10	1.10
RADIUM-228	301	19	1.68	0.52	22.04	199	17	1.35	0.67	11.46
THORIUM-228	301	11	0.21	0.05	0.86	199	21	0.20	0.05	0.33
THORIUM-230	301	74	0.20	0.03	1.58	199	52	0.20	0.04	1.75
THORIUM-232	301	7	0.12	0.02	0.66	199	10	0.11	0.04	0.51
URANIUM-234	200	4	0.37	0.09	6.51	170	13	0.28	0.09	0.95
URANIUM-235	200	0	0.28	0.09	N/A	170	1	0.23	0.12	0.24
URANIUM-238	200	1	0.34	0.13	2.98	170	7	0.29	0.09	0.79

5.1.5 Sulfate Results

Sulfate was analyzed from PM_{10} and TSP filters using standard method SW9056. Analytical results for sulfate detected on PM_{10} and TSP filters during 2006 are summarized in Appendix I. The masses detected on the PM_{10} filters were divided by the sample volumes in Table 2 to calculate the metals concentrations summarized in Table 9. The masses detected on the TSP filters were divided by the sample volumes in Table 3 to calculate the metals concentrations summarized in Table 10. A summary table of the sulfate results is provided below. Non-detected results were included in the average concentration calculation by assuming sulfate was present at the detection limit. This assumption will result in some averages having a high bias compared to the actual average concentration. Note that 14 results were qualified as non-detect during fourth quarter 2006 due to sulfate contamination in the method blank.

Annual 2006	PM_{10} Filters (µg/m^3)					TSP Filters (µg/m^3)				
Analyte	Sample Count	Qty. of Detects	Average Result	Min MDL	Max Detected Result	Sample Count	Qty. of Detects	Average Result	Min MDL	Max Detected Result
SULFATE	94	78	0.8	0.02	5.46	27	25	1.08	0.02	4.54

5.2 Meteorological Data

Meteorological data generated during 4Q 2006 consisted of precipitation, temperature, relative humidity, barometric pressure, solar radiation, wind speed, and wind direction. These meteorological parameters are summarized in Table 13 for all months in 2006 and discussed below.

5.2.1 Precipitation

All the precipitation measurements during 4Q 2006 by the meteorological station were flagged as rejected due to the malfunctioning rain gauge.

5.2.2 Temperature

The average, minimum, and maximum temperatures for each month of 4Q 2006 are presented in Table 13. The average monthly temperature measured by the meteorological station decreased from approximately 50ºF in October to 30ºF in December.

5.2.3 Relative Humidity

The average, minimum, and maximum relative humidity for each month of 4Q 2006 are presented in Table 13. The average monthly relative humidity measured by the meteorological station increased from 42 percent in October to 60 percent in December.

5.2.4 Barometric Pressure

The average, minimum, and maximum barometric pressures for each month of 4Q 2006 are presented in Table 13. The average monthly barometric pressure measured by the meteorological station was relatively constant at 855 mBar for the period.

5.2.5 Solar Radiation

Total monthly solar radiation measured by the meteorological station generally decreased from approximately 500,000 kJ/m^2 in October to approximately 250,000 kJ/m^2 in December.

5.2.6 Wind Speed

Wind speed for all monitoring events in 2006 is provided in Figure 4. The daily average, minimum, maximum, and standard deviation of all wind speed observations for each monitoring day are indicated on the chart. Wind speed measured by the meteorological station during 4Q 2006 ranged from approximately zero to 40 mph. During 4Q 2006, the highest average (13.91 mph) and maximum (35.72 mph) wind speeds occurred during Event 110 on November 13, 2006.

Wind speed frequency distribution for the year 2006 is presented in Figure 5. The wind speed measurements have been grouped according to general wind speed classes (e.g., 5 – 10 mph). The frequency of wind speed measurements is indicated for each wind speed class. The frequency distribution of wind speeds during 2006 indicated the majority (64 percent) of measurements were 5 mph or less. Approximately 20 percent of the total measurements were between 5 – 10 mph. Maximum wind speeds (greater than 20 mph) during 2006 represented about 4 percent of the measurements.

5.2.7 Wind Direction

Wind direction measurements collected over a period of time are best summarized by wind rose plots. These plots group wind direction measurements into ranges of degrees (0 to 22.5, 22.5 to 45, etc.) and represents the ranges by a vector on a radial chart. The length of the vector is determined by the number of measurements in that range compared to the total number of measurements. In addition, a wind rose plot may provide information on wind speed by coloring the vectors that correspond to wind speed ranges. Wind rose plots were created using Rose Works Joint Frequency Distribution Program software by UAI Environmental to display both wind direction and wind speed. Rose Works was used because it accepts raw data generated from the site meteorological station without the need to average or round values for pre-processing input files.

Wind rose plots are provided in Appendix J for a variety of time periods described below.

- Annual 2006 (January 1 to December 31, 2006; 34,912 observations)
- 2006 Events Only (59 Events; 5,664 observations)
- 4Q 2006 (October 1 to December 31, 2006; 8,795 observations)
- Each month in 4Q 2006 (October, November, and December; 2,976, 2,880, and 2,939 observations, respectively)
- Each monitoring event in 4Q 2006 (Events 103 through 116; 96 observations each)

As shown on the annual 2006 wind rose plot, which summarizes the entire data set, wind directions were variable with no direction accumulating more than 12 percent of the total measurements. However, when wind speeds were above 15 mph, wind direction is predominantly from the southwest to the northeast. The 2006 events only wind rose plot is nearly identical to the annual 2006 (entire data set) wind rose plot even though it has only a sixth of the observations. This indicates that wind speed measured during the 59 monitoring events in 2006 were an accurate representation of the measurements for the entire year.

As shown on the wind rose plot for 4Q 2006 and in the wind rose plots for each month in 4Q 2006, the predominant wind directions were from the southwest to the northeast followed by northeast to the southwest. When wind speeds were above 15 mph, the predominant wind direction was to the northeast. Individual wind rose plots for events during 4Q 2006 indicate that wind direction can be quite different from one event to the next.

The average PM_{10} and TSP concentrations measured during 4Q 2006 at each monitoring location are presented on Figures 6 and 7, respectively. Note that monitoring locations that are to the south and west (AM-1, AM-2, and AM-3) have average PM_{10} concentrations that are generally less than those measured to the north and east (AM-4, AM-5, and AM-6).

SECTION 6.0

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